

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

Claim 1 (original): A method of producing an elemental material or an alloy thereof from a halide of the elemental material or halide mixtures comprising introducing the vapor halide of an elemental material or halide mixtures thereof into a liquid phase of a reducing metal of an alkali metal or alkaline earth metal or mixtures thereof present in excess of the amount needed to reduce the halide vapor to the elemental material or alloy resulting in an exothermic reaction between the vapor halide and the liquid reducing metal producing particulate elemental material or alloy thereof and the halide salt of the reducing metal and sufficient heat to vaporize substantially all the excess reducing metal, and separating the vapor of the reducing metal from the particulate elemental material or alloy thereof.

Claims 2-27 (canceled)

Claim 28 (original): A method of producing Ti or a Ti alloy comprising introducing a Ti chloride vapor or a mixture of Ti chloride and other chloride vapors into a liquid continuum of a reducing metal of an alkali metal or alkaline earth metal or mixtures thereof initiating an exothermic reaction to form particulate Ti or Ti alloy and a chloride salt of the reducing metal, the reducing metal being present in excess of the stoichiometric amount required to react with the Ti chloride or mixture of Ti chloride and other chloride vapor, the exothermic reaction producing heat sufficient to vaporize substantially all the excess reducing metal, and separating the reducing metal vapor from the particulate Ti or Ti alloy and the chloride salt of the reducing metal.

Claims 29-37 (canceled)

Claim 38 (original): A method of producing Ti or a Ti alloy, comprising producing Ti or Ti alloy particulates in an exothermic reaction by introducing Ti chloride vapor or a mixture of Ti chloride and other chloride vapor into a flowing stream of liquid reducing metal of an alkali metal or an alkali earth metal or mixtures thereof, the reducing metal being present in an amount in excess of the stoichiometric amount required to react all of the Ti chloride or mixtures of Ti chloride and other chloride vapor, the heat of reaction vaporizing the excess liquid reducing metal such that substantially no reducing metal is present as a liquid after the reaction, the Ti or Ti alloy particulates moving in a first direction through a vessel, establishing a flow of inert gas to contact the Ti or Ti alloy particulates to separate the substantially all the excess reducing metal vapor from the Ti or Ti alloy particulates, and removing the Ti or Ti alloy particulates from the vessel.

Claims 39-45 (canceled)

Claim 46 (original): A method of producing Ti or a Ti alloy, comprising producing Ti or Ti alloy particulates from an exothermic reaction by introducing Ti chloride vapor or a mixture of Ti chloride and other chloride vapor into a flowing stream of liquid reducing metal of Na or Mg, the reducing metal being present in an amount in excess of the stoichiometric amount required to react all of the Ti chloride or mixtures of Ti chloride and other chloride vapor, the heat of reaction vaporizing substantially all the excess Na or Mg such that substantially no Na or Mg is present as a liquid after the reaction, the Ti or Ti alloy particulates moving downwardly through a vessel, establishing a flow of inert gas upwardly through the vessel for cooling the particulates and separating the excess Na or Mg vapor from the particulates, and

removing the Ti or Ti alloy particulates from the vessel.

Claims 47-50 (canceled)

Claim 51 (original): A method of producing Ti particles substantially free of Na, comprising introducing  $\text{TiCl}_4$  vapor into a liquid continuum of Na to produce Ti particles and NaCl and heat in an exothermic reaction, the Na being present in an amount in the range of about 25% to 125% by weight in excess of the stoichiometric amount of Na needed to reduce all the  $\text{TiCl}_4$  to Ti, the temperature of the reaction products of Ti and NaCl particles being maintained at less than about the boiling point of NaCl and greater than the boiling point of Na after the chemical reaction of  $\text{TiCl}_4$  and Na such that substantially all excess Na is in the vapor phase, the Na vapor being separated from the reaction products of NaCl and Ti with a moving gas, and thereafter separating the Ti from the NaCl.

Claims 52-59 (canceled)

Claim 60 (original): A system for the production of Ti or a Ti alloy, comprising a reactor for introducing a Ti halide vapor or a mixture of Ti halide and other metal halide vapor into a continuous phase of a liquid reducing metal to initiate an exothermic reaction reducing the halide vapor to produce reaction products of Ti or Ti alloy particulates and the halide of the reducing metal, the reducing metal being present in an amount greater than the stoichiometric amount needed to reduce the halide or halides but only in the amount which will substantially vaporize during the reaction, such that substantially no liquid reducing metal is present in the reaction products, a chamber wherein the reaction products are separated from the reducing metal vapor and the reaction products are cooled, and a separator in which the

halides of the reducing metal are separated from the Ti or Ti alloy particulates by washing with water.

Claims 61-70 (canceled)

Claim 71 (original): A method of producing an elemental material or an alloy thereof from a halide of the elemental material or halide mixtures comprising introducing the vapor halide of an elemental material or halide mixtures thereof into a liquid phase of a reducing metal of an alkali metal or alkaline earth metal or mixtures thereof present in excess of the amount needed to reduce the halide vapor to the elemental material or alloy resulting in an exothermic reaction producing particulate elemental material or alloy thereof and the halide salt of the alkali metal or alkaline earth metal or mixtures thereof, the temperature of the reaction products of the particulate elemental material or alloy thereof and the halide salt of the reducing metal being maintained at less than the boiling point of the halide salt of the reducing metal and greater than the boiling point of the reducing metal until substantially all excess reducing metal is vaporized, and separating the reducing metal vapor from the particulate elemental material or alloy thereof.

Claims 72-75 (canceled)

Claim 76 (original): A method of producing an elemental material or an alloy thereof from a chloride of the elemental material or chloride mixtures comprising introducing the vapor chloride of an elemental material or chloride mixtures thereof into a flowing liquid phase of a reducing metal of sodium or magnesium, sodium if present in the liquid phase is in the range of from about 25% by weight to about 125% by weight in excess of the stoichiometric amount required for the reduction of the

chloride vapor or magnesium if present in the liquid phase is in the range of from about 5% by weight to about 150% by weight in excess of the stoichiometric amount required for the reduction of the chloride vapor to the elemental material or alloy resulting in an exothermic reaction producing particulate elemental material or alloy thereof and sodium chloride or magnesium chloride and sufficient heat to vaporize substantially all the excess sodium or magnesium, and separating the sodium or magnesium vapor from the particulate elemental material or alloy thereof and sodium chloride or magnesium chloride with an inert sweep gas.

Claim 77 (original): A method of producing an elemental material or an alloy thereof from a chloride of the elemental material or chloride mixtures comprising introducing the vapor chloride of an elemental material or chloride mixtures thereof into a flowing liquid phase of a reducing metal of sodium or magnesium, sodium if present in the liquid phase is not more than by weight in excess of the stoichiometric amount required for the reduction of the chloride vapor or magnesium if present in the liquid phase is not more than about 75% by weight in excess of the stoichiometric amount required for the reduction of the chloride vapor to the elemental material or alloy resulting in an exothermic reaction producing particulate elemental material or alloy thereof and sodium chloride or magnesium chloride and sufficient heat to vaporize substantially all the excess sodium or magnesium, and separating the sodium or magnesium vapor from the particulate elemental material or alloy thereof and sodium chloride or magnesium chloride with an argon sweep gas.

Claim 78 (original): A method of producing Ti or Zr or alloys thereof from a chloride of Ti or Zr or chloride mixtures comprising introducing the Ti or Zr vapor

chloride or chloride mixtures thereof into a flowing liquid phase of a reducing metal of sodium or magnesium, sodium if present in the liquid phase is in the range of from about 25% by weight to about 125% by weight in excess of the stoichiometric amount required for the reduction of the chloride vapor or magnesium if present in the liquid phase is in the range of from about 5% by weight to about 150% by weight in excess of the stoichiometric amount required for the reduction of the chloride vapor to cause an exothermic reaction producing particulate Ti or Zr or alloys thereof and sodium chloride or magnesium chloride and sufficient heat to vaporize substantially all the excess sodium or magnesium while maintaining the temperature of the reaction products between the boiling point of the reducing metal and the boiling point of the salt produced, separating the sodium or magnesium vapor from the particulate Ti or Zr or alloys thereof and sodium chloride or magnesium chloride with an inert sweep gas of argon, and separating the particulate Ti or Zr or alloys thereof from the sodium chloride or magnesium chloride with water.

Claim 79 (original): A method of producing an elemental material or an alloy thereof from a chloride of the elemental material or chloride mixtures comprising introducing the vapor chloride of an elemental material or chloride mixtures thereof into a flowing liquid phase of a reducing metal of sodium or magnesium, sodium if present in the liquid phase is in the range of from about 25% by weight to 125% by weight in excess of the stoichiometric amount required for the reduction of the chloride vapor or magnesium if present in the liquid phase is in the range of from about 5% by weight to 150% by weight in excess of the stoichiometric amount required for the reduction of the chloride vapor to the elemental material or alloy resulting in an

exothermic reaction producing particulate elemental material or alloy thereof and sodium chloride or magnesium chloride and sufficient heat to vaporize substantially all the excess sodium or magnesium, and separating the sodium or magnesium vapor from the particulate elemental material or alloy thereof and sodium chloride or magnesium chloride with an inert sweep gas.

Claims 80-84 (canceled)